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represented several societies and institutions, and some were reported to have as many as eleven and twelve votes each, and three to seven votes was not unusual. However, the proportions remained about the same and the preponderance of votes rested with the Germans and Austrians.

The first session was devoted to preliminaries of organizing, and it was decided to postpone consideration of all questions pertaining to fossil plants and to the mosses and thallophytes until the next Congress, and that they be referred to a special commission to report in 1910 at Brussels. Six meetings were held, all well attended, and the results reached have been characterized "*as conservative but progressive.*" The priority of the specific name was adopted but the oldest generic name met with strong opposition and a list of four hundred exceptions, with the possibility of future additions and corrections, was adopted by vote of 118 to 37. Another surprising decision, that after January, 1908, all descriptions of new species must be accompanied by a short diagnosis in Latin, was adopted by a vote of 125 to 56. Several remarkable things happened during the sessions, one of which was the first attempt to use an evident majority by putting to vote without discussion, the first fifty-two articles of the code. This met with such strong opposition that it was abandoned, and the articles were each voted on separately.

The most sensational feature was the protest by Dr. Otto Kunze against its methods, representation, votes, decisions and recommendations of the commission. This was printed in three languages, and on the fourth day Dr. Kunze appeared in person and was listened to for ten minutes, while he read his protest. When the allotted time expired he was called to order and took his leave. He characterized the methods as dishonest, and stationed men at the door of the offices of the Congress to distribute his circular. It was rather surprising to see how calmly the members accepted his criticisms and how strongly the majority felt as a reaction against his procedure. It was evident, however, that European botanists have not begun to understand the principal of generic types, nor the absurdity of an arbitrary list of exceptions.

The hope has been expressed that the Vienna Code will be followed until something better is accepted, but it seems evident that English botanists are likely to follow the Kew Rule and Kew Index, and that newer American School will not give up a definite set of principles for arbitrary exceptions.  
New York Botanical Garden.

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### LICHENOLOGY FOR BEGINNERS—III.

FREDERICK LE ROY SARGENT.

(Begun in May, 1905, issue.)

Once set free and in the presence of sufficient moisture, air, and warmth, the spores germinate by sending out one or more tubular projections (rudimentary hyphæ) which branch and elongate until the food-supply stored in the spore is exhausted. Then if they do not come in contact with *Algae*,

which may serve as gonidia, they perish. But if proper *Algae* are encountered, then the hyphæ begin to grow vigorously and form a network of branches enveloping them. This first thin layer of hyphæ, called the *hypothallus*, remains a prominent feature of some adult lichens. With the

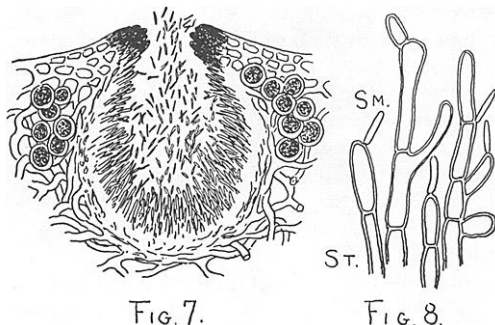


Fig. 7. The same. Vertical section of a spermagone, magnified about 200 diameters.  
Fig. 8. The same. Sterigmata (ST.) and spermatia (SM.), magnified about 1,500 diameters. (Original).

majority, however, as with *Parmelia*, it serves chiefly as a groundwork from which the thallus proper is developed, although it may persist to some extent in the rhizoids.

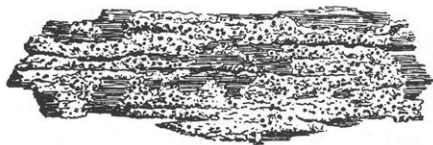


Fig. 9. *Acolium tigillare*. Slightly magnified. (Original).

ies, termed *spermatia* (SM.). These, when ripe separate readily from the sterigmata, and under the influence of moisture are extruded through the

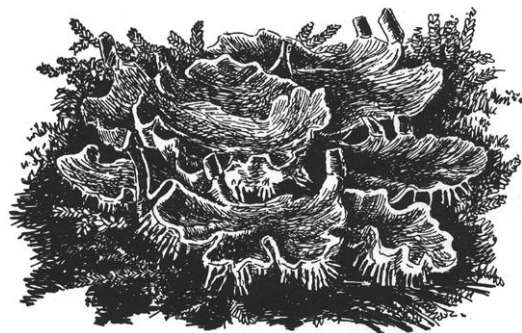


Fig. 10. *Peltigera canina*. Natural size. (After Kerner.)

The spermagones (Fig. 7. and SG., Fig. 2) are, as we have seen, flask-shaped cavities, opening by a minute pore. Into the cavity project innumerable short hyphal branches, called *sterigmata*, (ST., Fig. 8), which produce as out-

growths exceedingly minute bodies, termed *spermatia* (SM.). These, when ripe separate readily from the sterigmata, and under the influence of moisture are extruded through the pore in a mass of jelly. The function of the spermatia is somewhat obscure, their minuteness rendering investigation of them particularly difficult. In certain lichens there is evidence that they perform a service analogous to that of pollen—that is to say, they are male elements that fertilize a female cell,

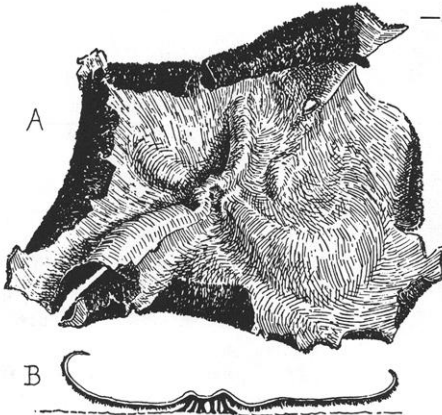


Fig. 11. *Umbilicaria Dillenii*. Natural size. A, view from above; B, diagrammatic vertical section, showing method of attachment to substrate. (Original.)



Fig. 12. *Ramalina calicaris*. Natural size. (After Rabenhorst.)

which subsequently gives rise to the spore-producing fruit. In such lichens as *Parmelia*, however, the most careful search has failed to discover any trace of a female organ, and there is other evidence that the spores arise in an entirely non-sexual manner. Moreover, the sper-

matia of such lichens have been found to germinate and produce a mass of hyphæ entirely similar to that grown from spores. The conclusion seems warranted, therefore, that the spermatia of the majority of lichens have in the course of evolution changed then function, and while they were originally male reproductive bodies, they now serve as supplementary non-sexual spores.

Having studied in detail one typical example, it remains for us to consider the principal modifications of form which the different parts of lichens exhibit.

The chief forms of thallus are briefly indicated in the following table:



Fig. 13. *Usnea barbata*. Natural size. (After Sachs.)

- |   |                     |
|---|---------------------|
| I. Closely united with the substrate, so as to appear like an incrustation; without rhizoids. (Fig. 9).....   | CRUSTACEOUS         |
| II. Attached to the substrate by rhizoids or by definite portions of the lower surface; lobes numerous or ample.....  | FOLIACEOUS          |
| 1. With numerous rhizoids or points of attachment.  |                     |
| a. Lobes lying close to the substrate. (Fig. 1).....  | ADNATE OR APPRESSED |
| b. Lobes ample and ascendant. (Fig. 10).....  | FRONDOSE            |
| 2. With a single point of attachment near the center. (Fig. 11).....  | UMBILICATE          |
| III. Arising from a single point of attachment, and growing more or less perpendicular to the substrate; branched and shrubby or pendulous, the branches flattened. (Fig. 12) or terete (Fig. 13).....  | FRUTICULOSE         |
| IV. Possessing both a horizontal and a vertical part, the former being crustaceous or foliaceous, and the latter consisting of individual members, called <i>podetia</i> , that may be goblet-shaped (Fig. 14, A), club-shaped, or cylindrical (Fig. 14, B), and either simple or branched..... | CLADONIAFORM        |

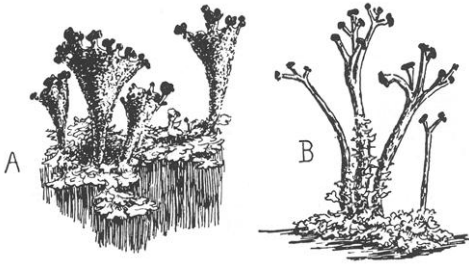


Fig. 14. A, *Cladonia pyxidata*; B, *Cladonia cristatella*. Natural size. (Original.)

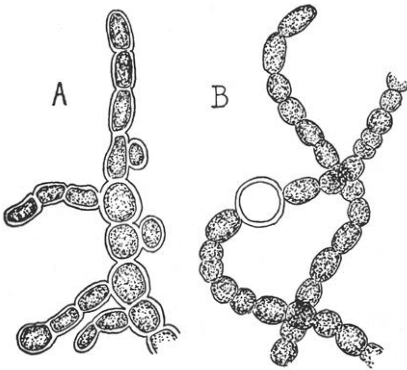


Fig. 15. A, gonidia of *Graphis scripta*; B, gonimia of *Leptogium*. Magnified about 250 diameters. (Original.)

As regards the character of its surface, the thallus may be smooth, with a bloom (*pruinose*), powdery (*pulverulent*), mealy (*tartareous*), scuffy, warty (*verruucose*), hairy (*tomentose*), cracked (*rimose*), covered with a network (*reticulate*), divided into small, regular spaces (*areolate*), or with indentations or depressions (*lacunose*).

In texture the thallus may be thin and papery (*membranaceous*), moderately firm (*cartilaginous*), or tough like leather (*coriaceous*).

Sometimes the soredia, instead of being mere granular heaps, become coral-like projections, and are then called *isidia*.

The different kinds of *Algae* which serve as gonidia are mostly either grass-green or bluish green. When bluish they are termed *gonimia*. Some of the commoner forms of gonidia are shown in Figs. 3 and 15.

In a few cases gonidia occur in

the hymenium, and are disseminated with the spores.

The principal forms of apothecia are as follows:

- I. Hymenium exposed when mature.....GYMNOCARPOUS
  - A. Hymenium solid at maturity.
    1. Rounded in outline, concave, flat, or convex.
      - a. Disk margined, at least when young, by a *thalline exciple*—that is, one which is continuous with the thallus and the same in color. (Figs. 2 and 4).....SCUTELLIFORM
      - b. Disk margined only by a *proper exciple*—that is, one which is a continuation of the hypothecium, and which does not contain gonidia.
        - \*Saucer-shaped or shield-shaped, with the exciple distinct at the margin. (Fig. 16, A).....PATELLIFORM
        - +Exciple coal-black.....LECIDEINE
        - ‡Exciple paler than the disk.....BIATORINE
        - §Strongly convex or globular, the exciple at length covered or obscured by the disk. (Fig. 16, B).....CEPHALOID
      - c. Disk margined by both proper and thalline exciples. (Fig. 16, C).....ZEORINE
    2. Elongated in outline, furrow-like, straight or curved, simple or branching. (Fig. 16, D).....LIRELLIFORM
  - B. Hymenium becoming a powdery mass of spores by disintegration of the thekes at maturity. (Fig. 16, E).....CRATERIFORM
- II. Hymenium enveloped in a *perithecium*—that is, a proper exciple which is spherical or flask-shaped, and at maturity opens by a spore at the summit, through which the spores escape like spermatia from a spermatogone. Within the perithecium is usually another layer (the *amphithecium*) which gives rise directly to the hymenium. (Fig. 16, F).....ANGIOCARPOUS

Spores may be colorless\* or colored (mostly brownish or olive). The typical forms of spores are illustrated in Fig. 17. As may be seen also in these illustrations, spores may be *simple*,—*i. e.*, consisting of but a single cell,—(A and C), or they may be divided by partition walls (*septa*) into two, four, or more compartments (*loculi*), when they are termed, respectively, *bi*-, *quadri*-, or *plurilocular* (D, E, I, H, and J). When there are longitudinal as well as transverse septa, the spore becomes *muriform* (F, G). When there is a small loculus at each pole (as in B) the spore is termed *polar-bilocular*.

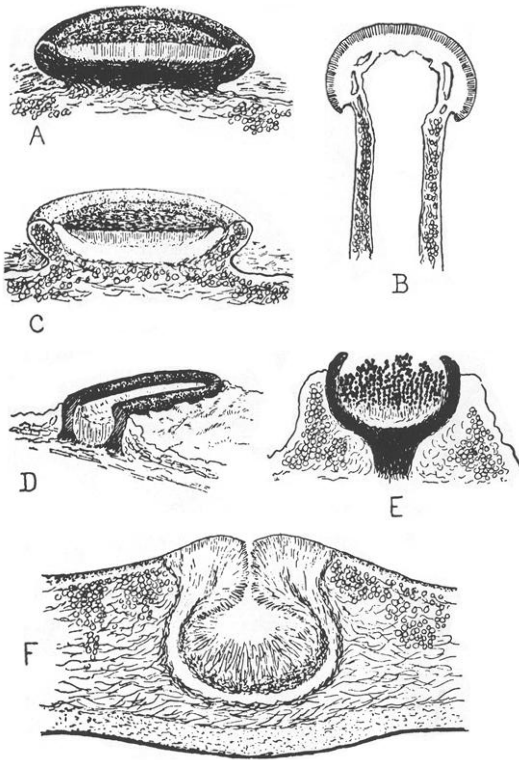


Fig. 16. Forms of apothecia. A, patelliform (*Lecidia*); B, cephaloid (*Cladonia*); C, zeorine (*Lecanora*); D, lireliform (*Graphis*); E, crateriform (*Acolium*); F, angiocarpous (*Endocarpon*). Various magnified. (Original.)

A few lichens have spores almost large enough to be seen with the naked eye; the majority are microscopic and in many cases exceedingly minute.

The spermagones of most lichens so nearly resembles the type as shown in *Parmelia* that they will be easily understood without further description.

The size of spores is commonly expressed in terms of the microscopical unit known as a *micromillimeter*, which is equivalent to one thousandth of a millimeter, and is indicated by the abbreviations *mic.*, *mm.*, or by the Greek letter micron,  $\mu$ . It is customary to write the length as the numerator of a fraction and the breadth as the denominator, and to indicate the minimum and maximum of each dimension. Thus for the spores of *Parmelia conspersa*,

\* According to Professor Tuckerman, elongated spores are typically colorless, while the broader forms are typically colored. Broad spores which are without color he calls *decolorate*.

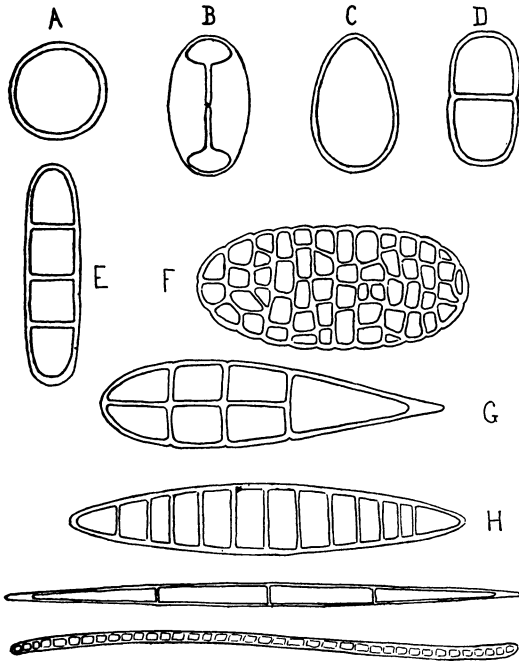


Fig. 17. Forms of spores. A, globose; B, ellipsoid; C, ovoid; D, oblong; E, dactyloid; F, oblong-ellipsoid; G, cymbiform; H, fusiform; I, acicular; J, cylindrical. A and C are simple; D, bilocular; E and I, quadrilocular; H and J, plurilocular; B, polar-bilocular; F and G, muriform. (Original.)

the value of the divisions should be carefully ascertained for each objective. Thus equipped it is an easy matter to measure the spores, and these measurements should be recorded on the label of the specimen together with a drawing of a spore, showing outline, number of septæ and (by shading) the presence of color.

(To be continued.)

which vary from .007 to .012 millimeters in length and from .005 to .007 in breadth we should write the expressions  $\frac{7-12}{5-7}$  mic. or  $\mu$ .

As soon as possible after an unknown specimen is collected it is desirable to examine the spores. Having made a thin section of the apothecium or removed a small portion of the hymenium, it may be treated with a little potassic hydrate on the slide and crushed somewhat under the cover glass. Iodine is sometimes useful as a coloring agent. It gives a yellowish or brownish tinge to protoplasm and turns the thekes blue. The microscope should be provided with an eyepiece micrometer and

## WHAT TO NOTE IN THE MACROSCOPIC STUDY OF LICHENS II.

BRUCE FINK.

### VARIATION IN LICHENS.

Before passing to a consideration of the gross morphology of the fruits of lichens, it may be stated that lichens are scarcely more varied as to form, size and color than many undoubted morphological units of the plant kingdom, and that the variations are by no means so great that these characters can not be depended on in the description and determination of species and